TINGIFAUNA OF SOUTHERN INDIA: DISTRIBUTION, HOST PLANTS, NATURAL ENEMIES AND GENERIC KEY[1]

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(With one plate and two text-figures)

Key words: Tingidae, southern India, distribution, host plants, egg parasitoids, generic key.

The pattern of distribution of 45 species belonging to 28 genera and 2 subfamilies of Tingidae of southern India, along with 56 species of their host plants and 5 species of their egg parasitoids, have been documented. Twenty species of tingids and four species of their egg parasitoids are new discoveries. Thirty two species of host plants are new records. Verbenaceous plants support a larger number of tingid species, whereas more species of Labiatae support the Ocimum tingid *Cochlochila bullita*. While *Tingis buddleiae* Drake is recorded only at 2500 m above msl, *C. bullita*, *Habrochila laeta* and *Teleonemia scrupulosa* occur at all elevations in this region throughout the year, *Teleonemia scrupulosa*, the Mexican Lantana lace bug, raises more than 12 generations in a year on *Lantana* weed and is well established in this region. *Paralleloptera polyphaga*, a mymarid egg parasitoid of more than twenty species of Tingidae, *Erythmelus empoascae*, also a mymarid egg parasitoid, *Lathromeromyia (lathromeromina) tingiphaga*, L (l.) *corythaumaii* and *Epoligosita* (*epoligositina*) *duliniae* of Trichogrammatidae have been reported as new. Generic key for 28 genera has been formulated.

INTRODUCTION

The Tingidae Laporte, commonly known as lace bugs and polyglottally known by different names in different countries, are relatively small (1.5 mm to 4.5 mm), phytosuccivorous cimicomorphs, with gorgeous lacy designs on their hemelytra. All the five instars and adults congregate underneath leaves, where they feed, moult, defecate and foul the area, causing chlorotic patches that betray their presence on the affected plant. Older instars move to more tender parts of the plant. The adults mate and insert their eggs into tender tissues such as mesophyll, tender stems, pistil and other floral parts, exposing only the operculum of the egg. With very few exceptions, all nymphal instars bear characteristic, species-specific body outgrowths (Plate 1) such as the tubercles that carry a tracheal branch (Livingstone, 1962 a & b, 1968, 1976 & 1978b). Only the cephalic tubercles are retained, as the loral, frontal, postgenal and antenniferous tubercles, in the adults. Species of *Copium* (*on Teucrium-Labiatae*) and *Paracopium* (*on Clerodendron*-Verbenaceae) are specialized cecidogenous anthophagous tingids, causing monolocular floral galls (Monad and Carayon, 1958; Drake and Mamet, 1961; Jaeger, 1976). Leaf curl galls are caused by *Corythauma ayyari* on *Jasminum* (Livingstone, 1962, 1977, 1978a). The mechanism of rotation of the eggs by 180° in the bursa, while ovipositing in the flower bud in gall - producing tingids, is still an unresolved question.

One of the earliest biocontrol agents tried in India at the Forest Research Institute, Dehradun, to control the mexican weed *Lantana*, is *Teleonemia scrupulosa* Stal, the Mexican Lantana lace bug, imported in 1941. The unfounded fear that this bug would become a

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threat to teak plantations forced the FRI insectary management to destroy the entire culture stock in 1943 (Khan, 1945; Roonwal 1952, 1953); but a few escaped and established themselves in the adjacent hill range. Interestingly, this insect that raises hardly two to three generations in a year in north India is very successfully established on *Lantana* in southern India, raising more than 12 generations a year (Livingstone *et al.* 1980, 1981b). Livingstone (1961, 1978b), on the basis of the incidence of population and sweating phenomenon, categorized the Tingidae of northern India into summer and winter species.

While the Coconut lace bug *Stephanitis typica* (Mathen, 1960; Mathen and Kurian, 1972; Mathen *et al.*, 1972), the Ocimum lace bug *Cochlochila bullita* (Samuel, 1939; Sharga, 1953; Mohanasundaram and Rao, 1973); the Brinjal lace bug *Urentius hystricellus* (Patel and Kulkarny, 1955), the Jasminum lace bug *Corythauma ayyari* (Livingstone, 1977) and the Barleria lace bug *Habrochila laeta* (Mohanasundaram and Basheer, 1963; Asari, 1972) are known to be alarmingly serious pests of agriculture and horticulture, the rest of the species are not pests.

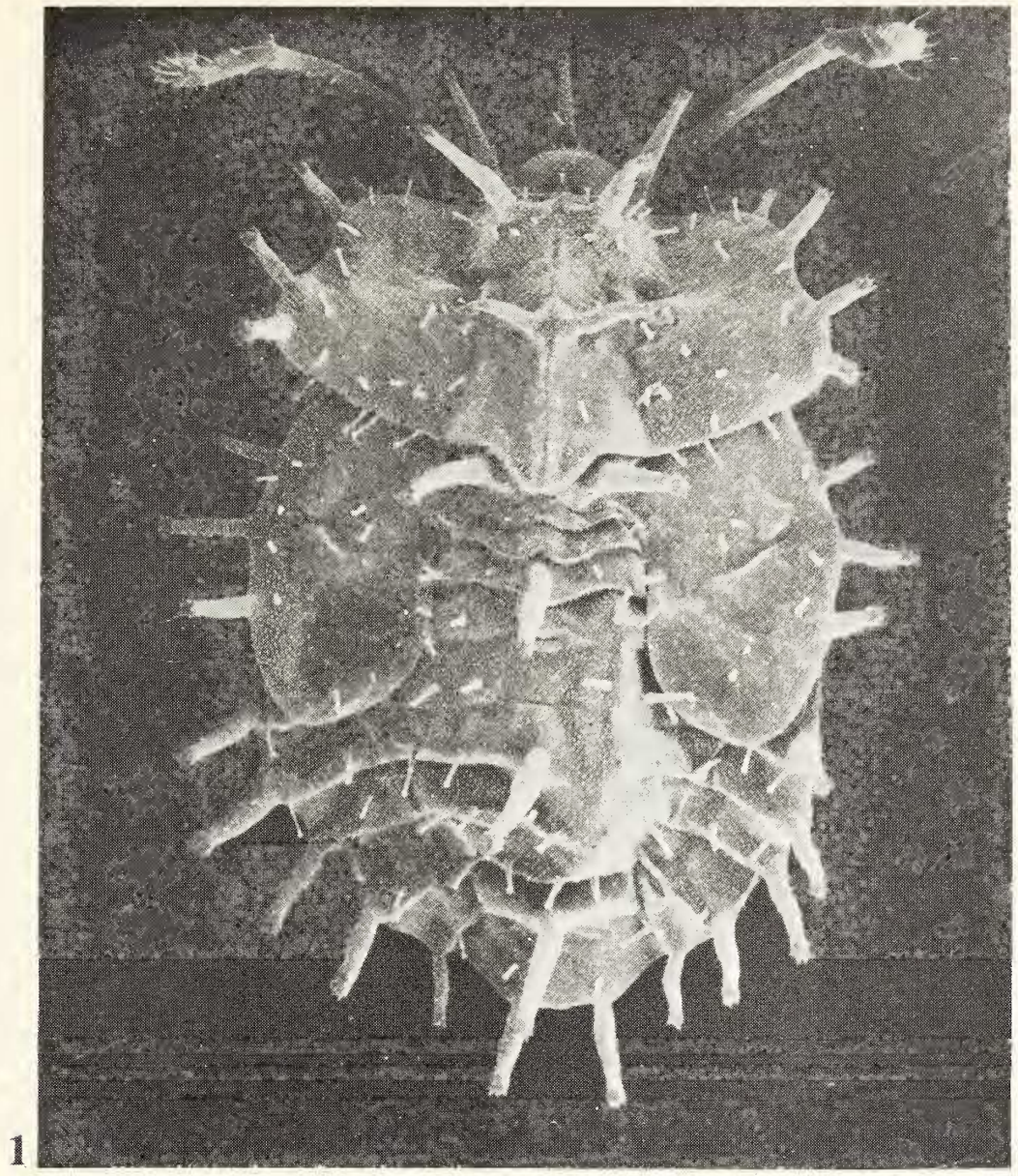
In their world catalogue of Tingidae, Drake and Ruhoff (1960, 1965) listed 1820 species belonging to 236 genera and 3 subfamilies. Of these, only 99 species of 49 genera and 2 subfamilies (Cantacaderinae and Tinginae) were known from India. The third subfamily Vianaidinae, whose members (4 species) are myrmecophilous, and whose nutritional and reproductive behaviours are not fully established, are not so far known from India. Since then, numerous species have been added from other parts of the world, mostly from the Ethiopian Region. After the publication of the taxonomic descriptions of 57 species of 30 genera and 2 subfamilies of Tingidae from India, Burma and Ceylon, by Distant (1904, 1910), the systematics of Oriental Tingidae has undergone substantial revision (Bergroth, 1911; Drake and Maa, 1953, 1954, 1955; Drake and Lutz, 1953). Menon and Hakk (1959a) reported a new subfamily called Phyllogastrotingis which was none other than the coreid *Craspidum*. Their (Menon and Hakk, 1959b) revision of the genus *Urentius*, with the addition of five more new species (*U. euphorbiae, U. indicus*; *U. pusaensis*; *U. sidae* and *U. ziziphifolius*), also was rejected as *nomen nudum* by Drake and Ruhoff (1965). Subsequently, Mohanasundaram (1962), Drake and Mohanasundaram (1961), Drake and Livingstone (1964), Livingstone (1972), Livingstone and Jayanthibai, 1993, 1994 a, b added more species to the checklist of Indian Tingifauna.

In most records, the host plants are "unrecorded". The first attempt in India to fill this lacuna was made by Livingstone (1961, 1962a) for north Indian species and subsequently by Mohanasundaram (1972) for a few South Indian species. The biology and population dynamics of not more than twenty Indian species are known (Iyengar, 1924; Samuel, 1939; Khan, 1945; Sharga, 1953; Patel and Kulkarny, 1955; Mathur, 1955, 1979; Mathen, 1960; Livingstone, 1959, 1968, 1976, 1978b; Livingstone *et al.*, 1980, 1981, 1982, 1983; Asari, 1972; Nair and Nair, 1974). The natural enemies of Tingidae in India have been identified by Livingstone (1962b, c, 1962, 1977); Mathen, Shantha and Kurien (1972), and the tingid egg parasitoids, representing Mymaridae and Trichogrammatidae (Hymenoptera) were reported by Livingstone and Yacoob (1982, 1987 a, b); Livingstone *et al.* (1982a, b).

In the present paper, we give primary importance to updating and documenting host plant records, and natural enemies of Tingidae and provide a key for the identification at least upto generic level.

1. Spatial Distribution

Ecosystem and altitude wise distribution of 45 species belonging to 28 genera and 2 subfamilies of Tingidae in the four southern states with more intensive survey of Tamil Nadu, are represented in Figs. 1 & 2 respectively. All are macropterous, performing short circled flights. *Cantacader*



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1. Nymph of *Habrochila laeta*, Barleria tingid
2. *Stephanitis typica* nymph. Globules of tubercles

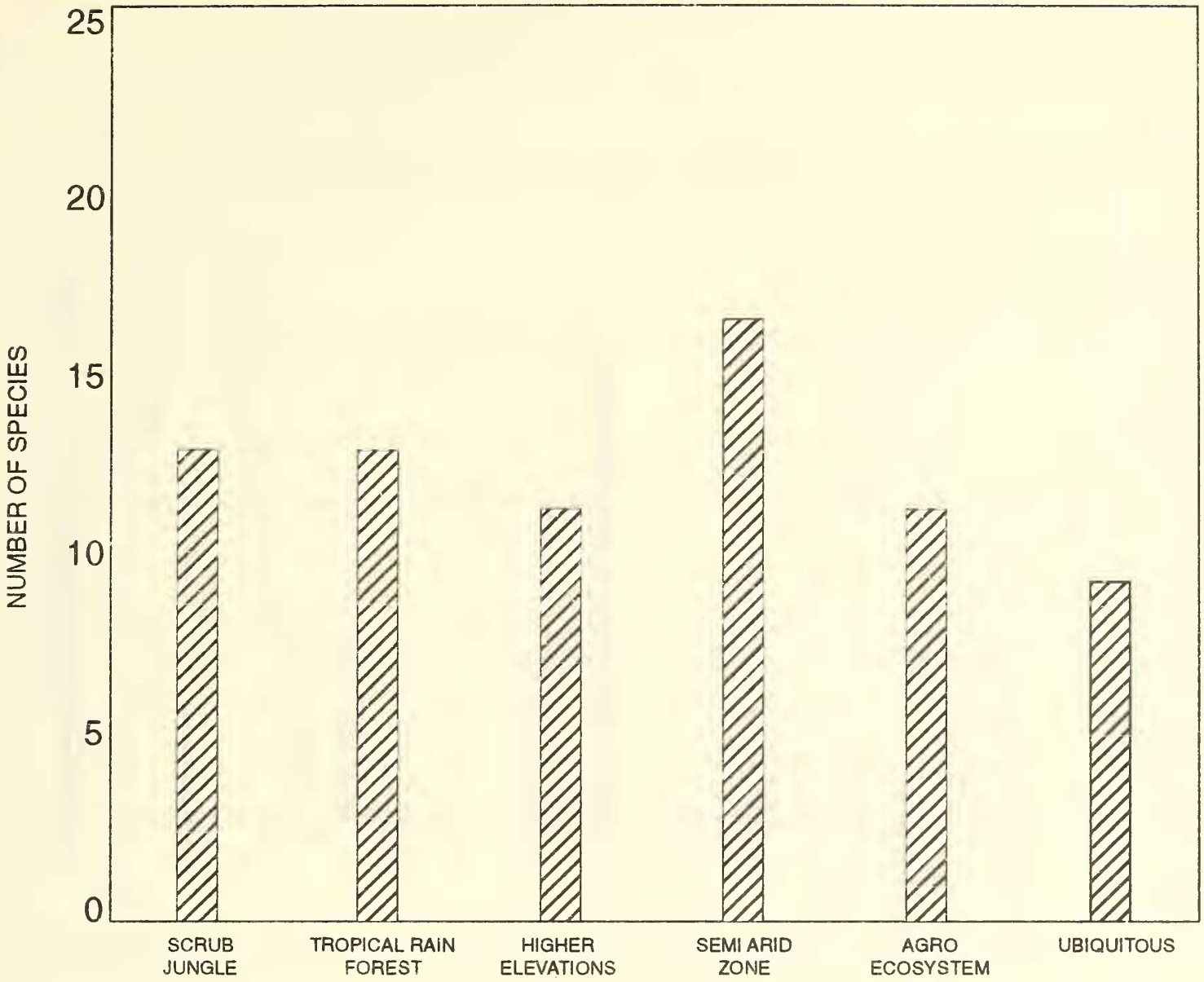


Fig. 1 Ecosystem-wise distribution of tingidae of southern India

quinquicostatus and *Balenus dentatus* are collected in light traps and their host plants are not known. In the former, no males are known and all specimens collected have been immature females. None of the known 30 spp. of *Cantacader* and 7 spp. of *Belenus* from the world have any host record and all were collected in light traps (Drake and Ruhoff, 1965; Livingstone 1972).

Every ecosystem has its representative tingifauna. The scrub jungle ecosystem that prevails in this region, extending from plains to moderate elevations, intervening agroecosystem and semiarid zones, records the maximum number of tingid species, the characteristic ones being *Afrotingis phanueli, Agramma therasii, Belenus dentatus, Cantacader quinquicostatus, Haedus grewii, Naochila nigra, Physatocheila asiatica* and *Tingis premnae*. The characteristic species of semiarid zone include *Agramma gramini, Ammiarus ravanus, Haedus manii*, and *Perissonemia ecmeles*. In the tropical rainforests more endemic species are recorded, namely *Corythauma gibbosa, Dictyla hessargattaensis, Eteoneous cinchonii, Haedus yacoobii, H. ruthii, Longiscutella menonii, Naochila minuta, Phatnoma costalis, Pontanus puerilis, Stephanitis charieis, S. cinnamomi* and *Tingis buddleiae*. The ubiquitous species include *Cochlochila bullita, Corythauma ayyari, Dulinius conchatus, Habrochila laeta, Phenotropis cleopatra, Stephanitis typica, Teleonemia scrupulosa, Urentius hystricellus* and *U. euonymus*.

Fig. 2 Vertical distribution of Tingidae and their parasitoids in southern India

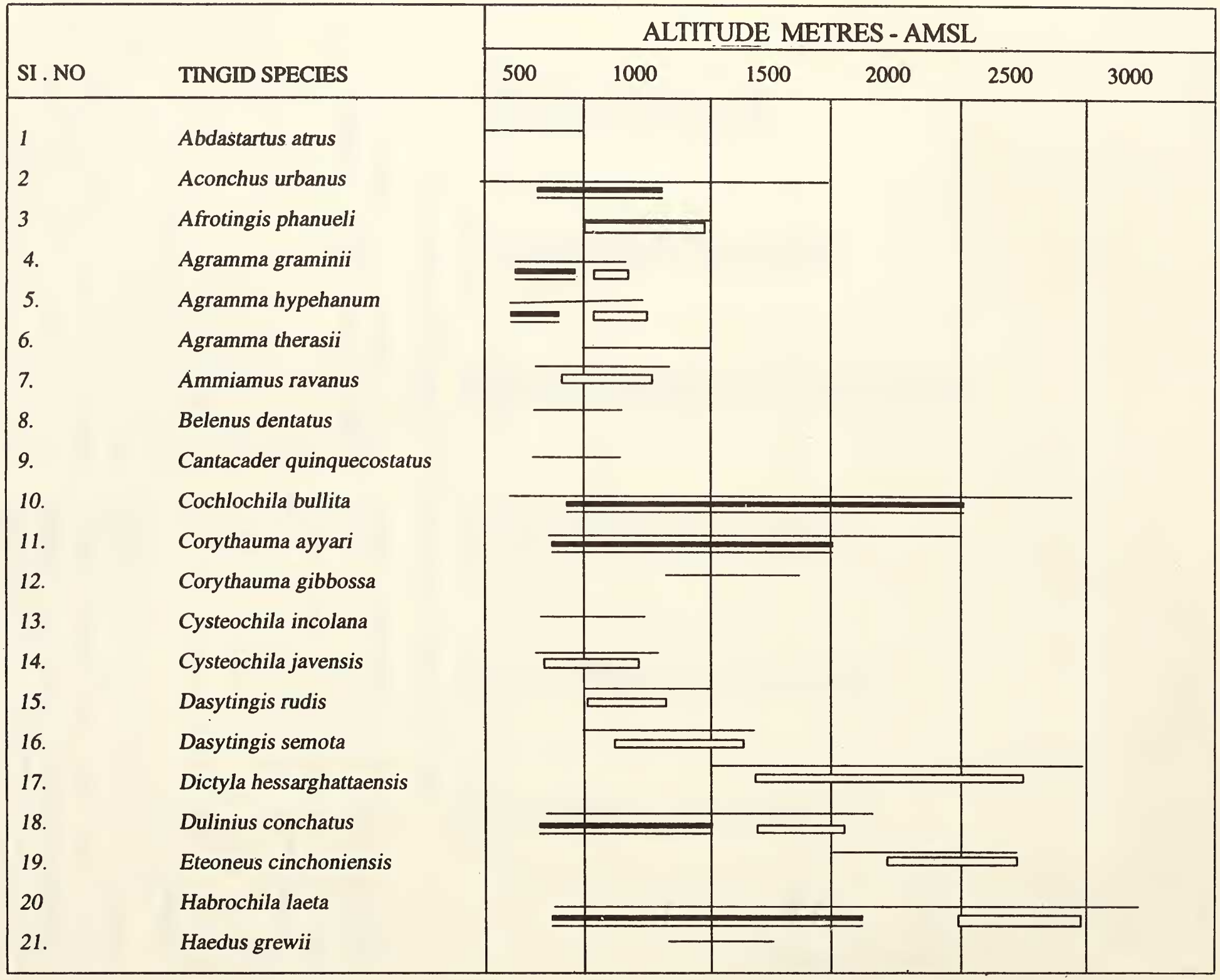
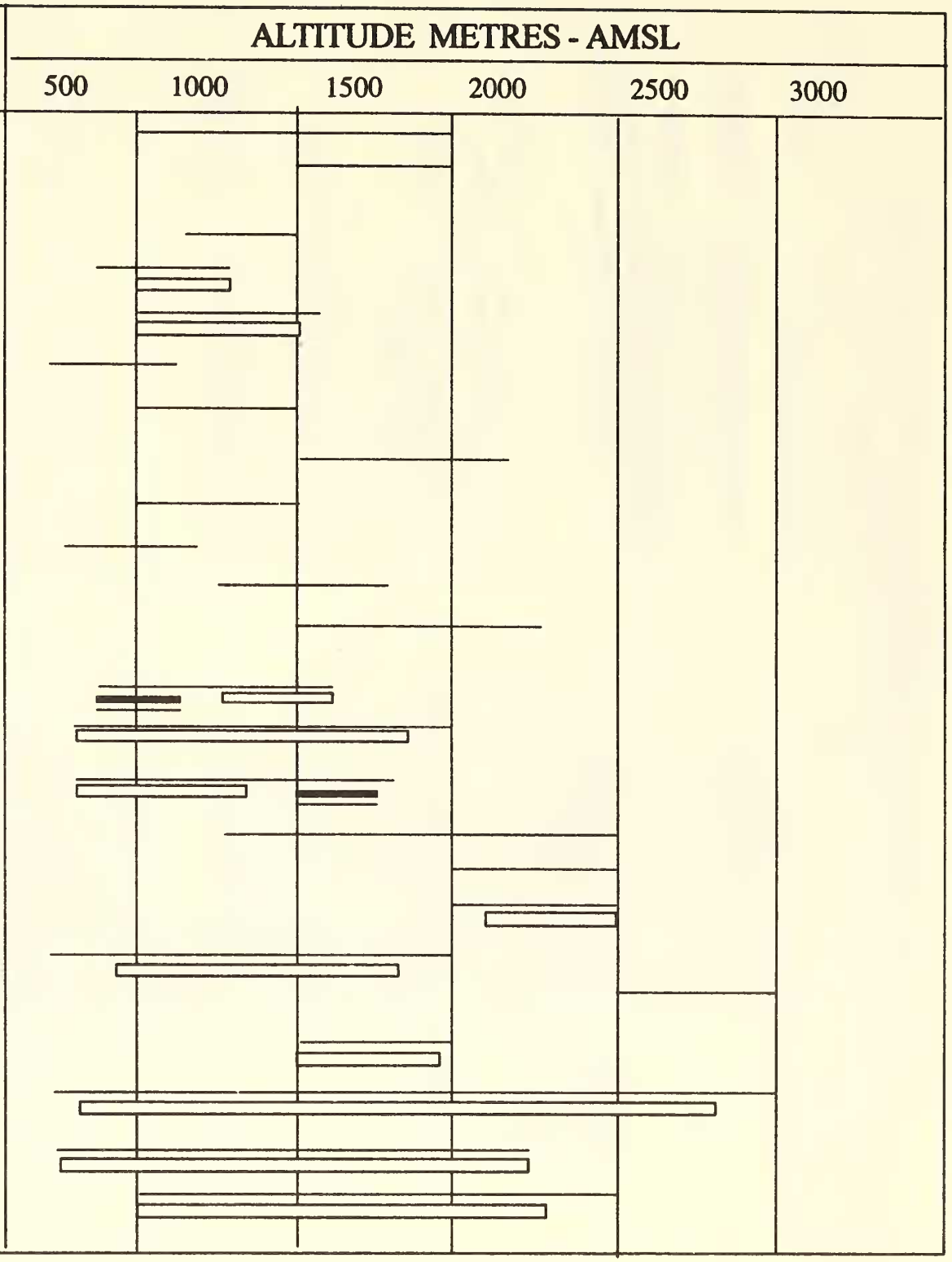


Fig. 2 *Contd.*

SI. NO	TINGID SPECIES
22	*Haedus manii*
23	*Haedus ruthii*
24	*Haedus yacobii*
25	*Lasiacantha justiciai*
26	*Lasiacantha peristrophii*
27	*Lasiacantha ruellii*
28	*Longiscutella menonii*
29	*Naochila minuta*
30	*Naochila nigra*
31	*Perissonemia ecmeles*
32	*Phatnoma costalis*
33	*Phatnoma laciniata*
34	*Physatocheila asiatica*
35	*Phaenotropis cleopatra*
36	*Pontanus puerilis*
37	*Stephanitis charieis*
38	*Stephanitis cinnamomae*
39	*Stephanitis macranthai*
40	*Stephanitis typica*
41	*Tingis buddleiae*
42	*Tingis premnae*
43	*Teleonemia scrupulosa*
44	*Urentius euonymus*
45	*Urentius hystricellus*



TRICHOGRAMMATIDAE MYMARIDAE TINGIDAE

TABLE 1
HOST PLANT RECORDS OF SOUTH INDIAN TINGIDAE (* NEW HOST RECORDS)

S.No.	Host family	Host plant	Tingid species
1.	Acanthaceae	*Barleria cristata* Linn.	*Habrochila laeta* Drake
		**Barleria mysoriensis* Roth.	"
		**Justicia prostata* Gamble	*Lasiacantha justiciaii* Livingstone & Jeyanthibai
		**Justicia simplex* D. Don	"
		**Ruellia (Justicia) prostata* Poir	*Lasiacantha ruelli* Livingstone & Jeyanthibai
		**Peristrophe bicalyculata* Nees	*Lasiacantha peristrophi* Livingstone & Jeyanthibai
2.	Boraginaceae	**Cynoglossum denticulatum* A. DC var zeylanicum C.B.Clarke	*Dictyla hessarghattaensis* Livingstone & Jeyanthibai
		**Cynoglossum furocatum* Wall.	"
		**Carmona microphylla* (Lamk.) Don.	*Naochila minuta* Livingstone & Jeyanthibai
		**Ehretia* sp.	*Naochila nigra* Livingstone & Jeyanthibai
3.	Euphorbiaceae	**Acalypha alnifolia* Klein ex Willd.	*Afrotingis phanueli* Livingstone & Jeyanthibai
		**Chryzophora rottleri* A. Juss.	*Urentius euonymus* Distant
4.	Graminae	**Chrysopogon fulcrus* (Spreng) Chiov.	*Aconchus urbanus* (Horvath)
		"	*Agramma hupehanum* (Drake & Maa)
		**Chrysopogon verticillatus* (Roxb)	*Agramma gramini* Livingstone & Jeyanthibai
		Saccharum officinarum Linn.	*Abdastartus atrus* (Motschulsky)
5.	Labiatae	**Colebrookea* sp.	*Eteoneus cinchonaensis* Livingstone & Jeyanthibai
		**Hyptis suaveolens* Poit.	*Cochlochila bullita* (Stal)
		Mentha sp.	"
		**Moschosma polystachyum* Benth.	"
		Ocimum basilicum Linn.	"
		Ocimum canum Sims.	"
		Ocimum gratissimum Linn.	"
		Ocimum sanctum Linn.	"
		**Orthosiphon glatratus* (Benth.)	"
		**Salvia coccines* Linn.	"
6.	Lauraceae	**Cinnamomum* sp.	*Stephanitis cinnamomae* Livingstone & Jeyanthibai
		**Persea macrantha* (Nees) Kostreum	*Stephanitis macranthai* Livingstone & Jeyanthibai
7.	Loganiaceae	*Buddleia asiatica* Linn.	*Tingis buddleiae* Drake
8.	Malvaceae	**Hibiscus rosa sinensis* Linn.	*Phatnoma costalis* Distant
		**Pavania zeylanica* Cav.	*Urentius euonymus* Distant
		Sida sp.	"
9.	Moraceae	*Artocarpus integrifolia* Linn.	*Stephanitis charieis* Drake & Mohanasundaram
		Ficus sp.	*Pexissonemia ecmeles* Drake & Mohanasundaram
10.	Musaceae	*Musa paradisiaca* Linn.	*Stephanitis typica* (Distant)
11.	Oleaceae	**Jasminum cardifolium* Wall.	*Corythauma ayyari* (Drake)
		Jasminum rigidum Zenk.	"
		Jasminum sambac Ait.	"
12.	Palmae	*Cocos nucifera* Linn.	*Stephanitis typica* (Distant)
13.	Papilionaceae	*Tephrosia purpurea* Pers.	*Phaenotropis cleopatra* (Horvath)
14.	Rubiaceae	**Borreria hispida* K.Sch.	*Cysteochila javansis* Drake & Poor
		**Morinda citrifolia* Linn.	*Dulinius conchatus* (Distant)
		Morinda tincotoria Roxb.	"
15.	Sterculiaceae	**Pterospermum obtusifolium* Wight	*Haedus ruthii* Livingstone & Jeyanthibai

TABLE 1(*contd.*)
HOST PLANT RECORDS OF SOUTH INDIAN TINGIDAE (* NEW HOST RECORDS)

S.No.	Host family	Host plant	Tingid species
16.	Solanaceae	*Solanum melongena* Linn.	*Urentius hystricellus* (Richter)
		Solanum torvum Swartz.	"
		Solanum trilobatum Linn.	"
		Solanum xanthocarpum Schrad & Wendal	"
17.	Tiliaceae	**Grewia villosa* Wild	*Haedus grewii* Livingstone & Jeyanthibai
		**Triumfetta pilosa* Roth	*Haedus yacoobi* Livingstone & Jeyanthibai
			Longiscutella menoni Livingstone & Jeyanthibai
18.	Verbenaceae	*Gmelina asiatica* Linn.	*Physatocheila asiatica* Livingstone & Jeyanthibai
		Lantana camara Linn.	*Teleonemia scrupulosa* Stal
		**Premna tomentosa* Wild.	*Tingis premnae* Livingstone & Jeyanthibai
		Tectona grandis Linn.	*Pontanus puerilis* (Drake & Poor)
		**Vitex negundo* Linn.	*Ammianus ravanus* (Kirkaldy)
			Dasytingis rudis Drake & Poor
			Dasytingis semota Drake & Lutz
		**Vitex trifolia* Linn.	*Dasytingis rudis* Drake & Poor
		"	*Dasytingis semota* Drake & Lutz
19.	Zingiberaceae	*Elettaria cardamomum* Maton	*Stephanitis typica* (Distant)

* New Host records

Most species occur in the plains and lower elevations below 2000 m above msl *Eteoneus cinchonii, Stephanitis cinnamomii, S. macranthii* and *Tingis buddleiae* occur at more than 2000 m above msl whereas, *Cochlochila bullita, Dictyla hessargattaensis, Habrochila laeta* and *Teleonomia scrupulosa* occur at all elevations.

No gall making tingids are known from this region, even though *Clerodendron* spp. are found at all elevations. The mymarid egg parasitoids are recorded at all elevations, whereas the trichogrammatid egg parasitoids occur in lower elevations (Fig. 2).

All species of Tingidae from southern India were found to be multivoltine, occurring throughout the year at varying population densities. Heavy rains wash away the life stages, even though they remain concealed underneath leaves and other parts of plants that become charred and crinkled during heavy infestation. Congregational feeding is a rule and positively geotactic behaviour among the grass tingids such as *Agramma* spp. and *Aconchus urbanus* is common. Almost all collections of these two genera were made from congregates in root mesh in loose, moist soil. Falling from twigs, feigning death and swift running towards the base of the stem when disturbed, are some of the evasive behaviour patterns of these bugs. Jerky movement characterise *Haedus* and *Lasiacantha* species. Body outgrowths of nymphal instars (Plate 1) secrete an adhesive substance for the arhenaceous materials, promoting camouflaging behaviour (Livingstone, 1976). The spreading rate of these bugs from one plant to another and from one region to another, apparently varies from about 4 km a year (Roonwal, 1952) in northern India to several kms, as in *Teleonemia scrupulosa* in southern India.

2. Host plants and host specificity

The largest number of species of tingids (130 spp.) so far recorded from all over the world, are on Leguminaceae (87 spp.), and the largest

TABLE 2
OCCURRENCE OF PARASITOIDS OF THE TINGID EGGS IN SOUTHERN INDIA

	Parasitoids	Host tingids	Host Plants
	MYMARIDAE		
a.	*Parallelaptera polyphaga* Livingstone & Yacoob	1. *Afrotingis phanueli*	*Acalypha* alnifolia Klein ex Willd
		2. *Agramma gramini*	*Chrysopogon verticillatus* Roxb.
		3. *Agramma hupahanum*	*Chrysopogonfulcrus* (Spreng) Chiov
		4. *Cochlochila bullita*	*Ocimum canum* Sims *Ocimum sanctum* Linn. *Ocimum basilicum* Linn.
		5. *Cysteochila javensis*	*Borreria hispida* & K.Sch.
		6. *Dasytingis rudis*	*Vitex negundo* Linn.
		7. *Dasytingis semota*	*Vitex trifolia* Linn.
		8. *Dictyla karnatica*	*Cynoglossum denticulatum* A.DC var. *zeylanicum* C.B. Clarke
		9. *Dulinius conchatus*	*Morinda tinctoria* Linn. *Morinda citrifolia* Linn.
		10. *Eteoneus cinchoniensis*	*Colebrookea* sp.
		11. *Habrochila laeta*	*Barleria cristata* Linn.
		12. *Lasiacantha justiciaii*	*Justicia prostata* Gamble
		13. *Lasiacantha peristrophii*	*Peristropha bicalyculata* Nees.
		14. *Lasiacantha ruellii*	*Ruellia* (*Justicia*) *prostata* Poir.
		15. *Phaenotropis cleopatra*	*Tephrosia purpurea* Pees.
		16. *Physatocheila asiatica*	*Gmelina asiatica* Linn.
		17. *Stephanitis macranthai*	*Persea macrantha*
		18. *Stephanitis typica*	*Cocos nucifera* Linn. *Musa paradisiaca* Linn.
		19. *Teleonemia* scrupulosa	*Lantana camara* Linn.
		20. *Tingis premnae*	*Premna tomentosa* Wild.
		21. *Urentius euonymus*	*Chrysophora rottleri* A. juss. *Pavania zeylanica* Cav. *Sida* sp.
		22. *Urentius hystricellus*	*Solanum melongena* Linn. *Solanum torvum* Swratz. *Solanum trilobatum* Linn. *Solanum xanthocarpum* Schrad & Wendl.
b.	*Erythmelus empoascae* Subba Rao	1. *Ammianus ravanus*	*Vitex negundo* Linn.
		2. *Pontanus puerilis*	*Tectona grandis* Linn.
		3. *Teleonemia scrupulosa*	*Lantana camara* Linn.

number of recorded species (98) of host plants belong to Compositae, that hosts 75 spp. of tingids. Only 33 species of tingids are known to be species specific, (Drake and Ruhoff, 1965).

In the present survey (Table 1) 45 species of tingids belonging to 28 genera and 2 subfamilies, are recorded on 58 species of host plants from 44 genera and 19 families; Verbenaceae is found to be the most favoured of all. As these bugs are poor fliers, host preference is detectable only when several plants of the same host species occur among several other species in the same locality at the same time. *Cochlochila bullita* is specific to the genus *Ocimum*, but it prefers *O. canum*, when all other species such as *O. sanctum*, *O. basilicum* and *O. gratissimum* are

TABLE 2 (*contd.*)
OCCURRENCE OF PARASITOIDS OF THE TINGID EGGS IN SOUTHERN INDIA

	Parasitoids	Host tingids	Host Plants
	TRICHOGRAMMATIDAE		
a.	*Lathromeromyia* (l) *tingiphaga* Livingstone & Yacoob	1. *Aconchus urbanus*	*Chrysopogon fulcrus* (Spreng) Chiov.
		2. *Agramma graminii*	*Chrysopogon verticillatus* Roxb.
		3. *Agramma hupehanum*	*Chrysopogon fulcrus* (Spreng) Chiov.
		4. *Cochlochila bullita*	*Ocimum canum* Sims. *Ocimum sanctum* Linn. *Ocimum basilicum* Linn. *Mentha* sp.
		5. *Habrochila laeta*	*Barleria cristata* Linn.
b.	*Lathromeromyia* (1) *corythaumaii* Livingstone & Yacoob	1. *Corythauma ayyari*	*Jasminum cordifolium* Walk. *Jasminum rigidum* Zenk. *Jasminum sambac* Ait.
c.	*Epoligositae* (*e.*) *duliniae* Livingstone & Yacoob	1. *Dulinius conchatus*	*Morinda tinctoria* Linn. *Morinda citrifolia* Linn.
		2. *Physatocheila asiatica*	*Gmelina asiatica* Linn.

also present in the same locality. Spreading occurs only in the event of *O. canum* being completely destroyed and when the other species of *Ocimum* are not in the vicinity, they spread on adjacent plants of Labiatae such as *Mentha, Salvia, Orthosiphon, Hyptis, Moschosma* etc., and raise one or two generations on them.

Similarly, *Corythauma ayyari* is specific to *Jasminum* sp. But it rarely attacks *J. primulium* and *J. grandiflorum*, when heavy infestation occurs on *J. sambac, J. multiflorum* and *J. pubescens* that grow in the same locality and elsewhere. While *Urentius hystricellus* is confined only to Solanaceae, with specific preference to *Solanum melongena, Urentius euonymus* that enjoys a permanent abode on the perennial, *Abutilon indicum,* attacks several other malvaceous annuals as well as *Chrysophora rottleri* of Euphorbiaceae. Most other species have been found to be host specific.

Plot effect characterises tingid attack in this region. By this, several bushes of the same locality and adjacent localities remain refractile to tingid attack when a bush in the middle remains susceptible and subjected to heavy attack. Plot effect in Tingidae is reported by Livingstone (1962c, 1968,1977), Asari (1972), Harley *et al.* (1979) and Livingstone *et al.* (1981b). It is difficult to ascribe the status of a primary host plant in the context of polyphagy because nothing deters this bug from raising one or two generations on any host plant that it invades during heavy infestation, and diapause phenomenon is not yet known in these bugs in this temperate region. Khan (1945) tried forced feeding of *Teleonemia scrupulosa* on teak leaves and reported that such nymphs never completed development.

Several species of a genus of different genera of host plants are simultaneously attacked by different species of the same genus of tingids, *Lesiacantha justiciaii, L. peristrophic* and *L. ruellii* are found on *Justicia prostata, Justicia simplex, Peristropha bicalyculata* and *Ruellia prostata*, all are members of the family Acanthaceae. Similarly, *Naochila nigra* and *N. minuta* attack *Ehretia* sp. and *Carmona microphylla* respectively, of the family Boraginaceae. Diverse species of diverse genera

of tingids are also found on plants of the same genus. The grass tingids such as *Aconchus urbanus*, *Agramma gramini* and *Agramma hupehanum* are found on the grass *Chrysopogon fulerus*, *C. verticullatus* and *C. fulerus* respectively. More than one species of tingids concurrently attacking the same host plant is also common. *Dasytingis rudis*, *D. semota* and *Ammianus ravanus* are found affecting *Vitex negundo* at different localities at the same time. *Headus yacoobii* and *Longiscutella menonii* are found concurrently on the same host plant *Triumfetta pilosa.*

3. Natural enemies

The list of the natural enemies of Tingidae does not appreciate much in space and time, being variable regionwise and countrywise. Coleopteran, neuropteran, thysanopteran, dermapteran, heteropteran and acarinid predators as well as brachonid, mymarid and trichogrammatid parasitoids have been reported on stray cases of tingids by a few authors. Larvae and adults of *Coccinella* spp. (Coccinellidae); *Chrysopa* spp. (Neuroptera); *Stethoconus praefactus/Apollodotus praefactus* (Miridae) and *Xystieus cristatus* (Acarinidae) have been recorded as predators of economically important species of Tingidae in India by Mathen, Shantha and Kurien, (1972) and Livingstone, (1968). Among the five chalcidoid egg parasitoids so far recorded in this region (Table 2), the mymarid *Erythmelus empoascae* Subba Rao, originally reported as an egg parasitoid of Jassidae, is now known to be an egg parasitoid of the teak tingid, *Pontanus puerilis*, Lantana tingid *Teleonemia scrupulosa* and the Vitex "giant" tingid, *Ammianus ravanus*, all three of which have long operculate eggs. The second mymarid *Parallelaptera polyphaga* Livingstone & Yacoob is highly polyphagous, so far recorded on no less than 22 species of Tingidae, at all elevations. Polymorphism of the female genitalia, corresponding to the opercular height of the host egg, has been considered as convincing evidence of biodiversity in parasitoid-host relationship (Livingstone and Yacoob 1986). The three species of trichogrammatid egg parasitoids are:- *Lathromeromyia* (*lathromeromina*) *tingiphaga* Livingstone & Yacoob, which is predominantly found on grass tingids such as *Aconchus urbanus*, *Agramma hupehanum* and *A.graminii*, as well as on the Barleria tingid, *Habrochila laeta* and the Ocimum tingid *Cochlochila bullita; Lathromeromyia* (*lathromeromina*) *corythaumai* Livingstone & Yacoob which is specific to the Jasmine tingid, *Corythauma ayyari* and *Epoligosita* (*epoligositina*) *duliniae* Livingstone & Yacoob which is specific to the Morinda lace bug, *Dulinius conchatus*. Parasitised tingid eggs always exhibit the characteristic development of the compound eyes and the ocelli of the pupating parasitoid at the cephalic end and the accumulation of the meconium at the caudal end.

GENERIC KEY FOR THE IDENTIFICATION OF THE SOUTH INDIAN TINGIDAE

a. Subfamily: Cantacaderinae Stal
Stenocostal area present, cephalic tubercles 4 in number; bucculae far exceeding the limit of the head ..... *Cantacader* Amyot & Serville

— Stenocostal area absent: 7 porrect cephalic .... *Phatnoma* Fiebr.

b. Subfamily: Tinginae Laporte

1. Cephalic tubercles either absent or reduced to not more than three nodules; paranotum present or absent; pronotum either with median carina or with very much reduced median and lateral carinae 2

— Cephalic tubercles always five in number; paranotum either reduced or highly expanded: pronotal hood either absent or highly expanded 3

2. Cephalic tubercles absent: pronotum with lateral spine; paranotum absent ..... *Eteoneus* Distant

— Cephalic tubercles reduced to a single pair of nodules (loral pair): either small or large in size; paranotal expansion wanting: pronotum with only a median carina; hemelytra without tumid elevations 2a

— Cephalic tubercles 3: moderately tuberculate; small to median size; paranotal expansion well developed and reflexed back upon the pronotum

with varying degrees of complexity: cephalic hood present or absent: hemelytra with tumid elevation: median carina well formed, often concealed by the paranotal expansion, lateral carinae moderately developed 2b

2a. Minute to small, antennae short, the first flagellar segment not exceeding double the length of the terminal segment, often setaceous; body elongate; hemelytra without any markings .... *Agramma* Stephens

— Body oval, hemelytra with dark patch .... *Afrotingis* Drake & Hill

— Larger size: more elongated, antennae very long, the first flagellar segment more than three times longer than the terminal segment, almost bare; distinct cell present .... *Perissonemia* Drake & Poor

2b. The paranotal expansion completely reflexed back and completely covering the pronotum on either side of the median carina; pronotal hood moderately developed; bucculae not prominently projecting anteriorly beyond the level of the head; minute to medium size; discoidal area vesicular ..... *Naochila* Drake

— Paranotal expansion reflexed but not completely covering the pronotum on either side of the median carina 2c

2c. Paranotal expansion reflexed and almost reaching the pronotum, leaving a narrow space on either side of the median carina; discoidal area with only tumid elevation; bucculae anteriorly protruding beyond the level of the head: moderately large ..... *Dictyla* Stal

— Paranotal expansion developing as a vesicle but not touching the pronotum: the median carina hairy, not forming vescile anteriorly the lateral carina uniseriate but concealed by the paranotal vesicle; 2 tumid elevations along the radial vein ..... *Cochlochila* Stal

3. Pronotal hood present; paranotal expansion well developed and elaborately expanded 4

— Pronotal hood absent: paranotal expansion either absent or when present broadly expanded 5

4. Pronotal hood laterally compressed and moderately gibbose, elongate, extending beyond the base of the head; paranotal expansion earlobe-like, uniseriate or multiseriate 6

— Pronotal hood moderately bulbous: paranotal expansion multiseriate, not extending beyond the base of the head. 7

— Pronotal hood enormously gibbose: paranotal expansion uniformly broad, vertically uniseriate or multiseriate and reflexed back on the pronotum and often extending beyond the base of the head 8

5. Paranotal expansion absent or narrow and uniseriate: cephalic tubercles either prominently stout or slender 5a

— Paranotal expansion broadly expanded or foveated: cephalic tubercles conspicuously spinous: hemelytra angulate 5b

5a. Paranotal expansion absent, only median carina present and the pronotum darkly punctate: cephalic tubercles very feeble .... *Phaenotropis* Horvath

— Paranotal expansion uniseriate: pronotum tricarinate, each carination uniseriate; hemelytra bare or with spines: cephalic tubercles prominently elongate 5c

5b. Paranotal expansion broadly expanded anteriorly with spines on the anterior margin, otherwise with long non-pedicellate hairs..... *Belenus* Distant

— Paranotal expansion deflected back opposed in the pronotum of either side of the median carination and transversely foveated: body dorsally clothed with sharp pedicellate spines ..... *Urentius* Distant

5c. Antennal segment highly setose: flagellar segments stout: hemelytral constriction not well defined: body moderately elongate .... *Teleonemia* Costa

— Antennal segment very slender and elongate: body slim and much elongated with prominent subapical constriction of hemelytra: paranotum anteriorly pointed reaching the eye 5d

5d. Body very much elongated: bare, lacking spines: legs very long; with spatulate hairs on the distitarsus ..... *Abdastartus* Distant

— Body moderately elongate, clothed with both decumbent and punctate hairs: ommatidia with setal combs: pterostigma on the radial vein may or may not present..... *Haedus* Distant

6. Paranotal expansion earlobe-like vertically uniseriated: pronotal median carina laterally compressed anteriorly and sharply pointing, extending beyond the head; the median carina and scutellum together forming vesicle: hemelytral areolations much limited in number with tumid elevations in the discoidal area: body non-spinous ..... *Aconchus* Horvath

— Paranotal expansion broadly expanded, multiseriate; median carina deeply constricted in the middle, anteriorly developed into moderately expanded vesicle and posteriorly into vertical

multiseriate plate; lateral carinae raised, uniseriate; hemelytra subapically constricted and body clothed with pedicellate spines .... *Lasiacantha* Stal

7. Middle region of the paranotal expansion developed into a transversely elongate multiseriate plate; hood more prominent; largest known among tingids; subcostal area multiseriate: hemelytra banded in the middle and the sutural area pigmented ..... *Ammianus* Distant (largest species recorded in S. India)

— Paranotal expansion either gradually enlarged in the middle or uniformly broad 7a

— Paranotal expansion deflected back and fused along the margin of the pronotum; the head and pronotum beset with stramineous hairs .... *Physatocheila* Fieber

7a. Paranotal expansion moderately prominent only in the middle; the hemelytra banded in the middle and the sutural area pigmented: large in size ..... *Dasytingis* Drake & Poor

— Paranotal expansion broad, marginally wavy and dentate: multiseriate or slightly reflexed on the pronotum and then deflexed vertically 7b

7b. Paranotal expansion broad; multiseriate and marginally wavy and dentate; body bare..... ..... *Pontanus* Distant

— Paranotal expansion slightly reflexed on the pronotum and then deflexed vertically, body tomentouse; areolae with cartwheel arrangement of hairs ..... *Tingis* Fabricius

8. Paranotum vertically uniseriate or 2-3 areolae thick, hemispherical or earlobe-like or broadly expanded extending beyond the eye; hemelytra with tumid elevation or vesiculate..... 8a
Paranotum either narrow and transversely uniseriate or broad and multiseriate: median carina constricted behind the anterior hood or not constricted or terminating midway 8b

8a. Paranotal expansion auricular or hemispherically expanded: discoidal area or discoidal and radial area together forming vesicle: lateral carinae expanded or not visible: median carina posteriorly expanded with the scutellum or not 8c

— Paranotal expansion broad and anteriorly extending upto the eye; median carina not forming any hood behind the anterior vesicle; lateral carinae short and reduced; radial area vertically disposed ..... *Stephanitis* Stal

8b. Paranotal expansion broad and multiseriate: median carina constrictd in the middle and posteriorly extending along with the scutellum far beyond the middle of the discoidal area; body almost bare .... *Longiscutella* Livingstone & Yacoob.

— Paranotal expansion narrow and uniseriate or multiseriate and reflexed; median carina not constricted and scutellum not extending beyond the anterior half of the discoidal area 8d

8c. Paranotum hemispherically expanded: median carina posteriorly not expanded but the lateral carinae expanded and meeting above the median carina: forming a vesicle. concealing the entire scutellum, discoidal area alone vesicular .... *Dulinius* Distant

— Paranotum auricular, median carina anteriorly and posteriorly forming vesicles; the posterior one completely concealing the scutellum: the lateral carinae absent; discoidal and radial areas together forming the vesicle..... *Habrochila* Horvath

8d. Paranotal expansion narrow, uniseriate, the anterior hood of the median carina almost completely concealing the head; scutellum obtusely pointed ..... *Corythauma* Drake & Poor

— Paranotol expansion multiseriate and reflexed, covering the pronotum lateral to the lateral carination ..... *Cysteochila* Stal

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